CLAIMS

What is claimed is:

1. A micromachined optical scanner, comprising:

a base;

a scan plate coupled to the base in a manner that permits the scan plate to rotate relative to the base about an axis of rotation;

a first actuator element mechanically coupled to the scan plate;

a second actuator element mechanically coupled to the scan plate;

a first driver element electromagnetically coupled to the first actuator element; and

a second driver element capacitively coupled to the second actuator element.

2. The micromachined optical scanner of claim 1 wherein the first actuator element is a conductive coil.

3. The micromachined optical scanner of claim 2 wherein the second actuator element includes a movable comb.

4. The micromachined optical scanner of claim 2 wherein the second actuator element includes a substantially planar electrode.

5. The micromachined optical scanner of claim 1 further including a torsion arm that supports the scan plate.

6. The micromachined optical scanner of claim 5 wherein the first actuator is mechanically coupled directly to the torsion arm.

7. The micromachined optical scanner of claim 5 wherein the first actuator includes a first capacitive plate positioned on one of the torsion arm and the movable mass; and the first driver element includes a second capacitive plate positioned to produce an electrostatic force between the first and second capacitive plates when a voltage is applied between the first and second capacitive plates.

8. A microelectromechanical resonant device, comprising:

a base;

a movable body coupled to the base for resonant motion relative to the base about a pivot axis;

a comb drive coupled to the movable body and oriented to produce a torque about the pivot axis; and

a magnetic coil carried by the movable body and oriented to produce a torque about the pivot axis.

9. The microelectromechanical resonant device of claim 8 further including:

a first substantially planar electrode carried by the movable body; and

a second electrode positioned to produce an electrical field extending between the first and second electrodes.

10. The microelectromechanical resonant device of claim 8 wherein the movable body and a portion of the comb drive form an integral body.

11. The microelectromechanical resonant device of claim 8 wherein the base and movable body are both formed from a semiconductor material.

12. The microelectromechanical resonant device of claim 8 wherein the movable body includes a polysilicon material.

13. The microelectromechanical resonant device of claim 8 further comprising a gimbal ring interposed between the base and the movable body, the frame being coupled to the base and configured for movement about a second axis substantially orthogonal to the pivot axis.

14. A MEMS scanner, comprising:

a base;

a scan plate supported by the base and allowed to rotate about an axis;

a first conductive coil, clockwise-wound and formed on the scan plate on a first side of the axis;

a second conductive coil, counter-clockwise-wound and formed on the scan plate on a second side of the axis; and

a magnet assembly coupled to the base and positioned to provide a vertical magnetic B field across the first and second conductive coils.

15. The MEMS scanner of claim 14, wherein:

the first and second conductive coils are wired in series.

16. The MEMS scanner of claim 15, further comprising:

only a single pair of leads electrically coupled to the first and second conductive coils.

17. The MEMS scanner of claim 14, wherein the magnet assembly further includes:

a vertically-polled magnet beneath the scan plate.

18. The MEMS scanner of claim 14; wherein the magnet assembly further includes:

a vertically polled magnetic body beneath the base, around the perimeter of the scan plate.

19. The MEMS scanner of claim 18, wherein the vertically polled magnetic body includes:

a plurality of individual magnets.

20. The MEMS scanner of claim 18, wherein the magnet assembly further includes:

a plurality of magnets beneath the base, inside the perimeter of the scan plate polled radially to the center of the scan plate.